

Appl. No. 10/538,284
Amendment dated: January 2, 2008
Reply to OA of: July 3, 2007

REMARKS

Applicants have amended the claims to more particularly define the invention in view of the outstanding Official Action. Applicants have amended claims 1, 4 and 6 to better define the invention and as fully supported by the specification as would be appreciated by one of ordinary skill in the art to which the invention pertains. See for example the specification beginning at page 12 and the accompanying drawings. Applicants submit that the claims now present in the application are fully supported by the specification as originally filed and no new matter is introduced.

Applicants most respectfully submit that all of the claims now present in the application are in full compliance with 35 USC 112 and clearly patentable over the references of record.

The rejection of claims 1-13 under 35 USC 103(a) as being unpatentable over U.S. Patent No. 6,288,401 to Chang, in view of Winkler has been carefully considered but is most respectfully traversed in view of the amendments to the claims and the following comments.

The purpose of Chang (U.S. Patent No. 6,288,401) is to correct an electron beam to the optical axis of the aperture of the extractor centering after mechanical pre-alignment of the emitter and the extractor in order to reduce the difficulty of the mechanical alignment.

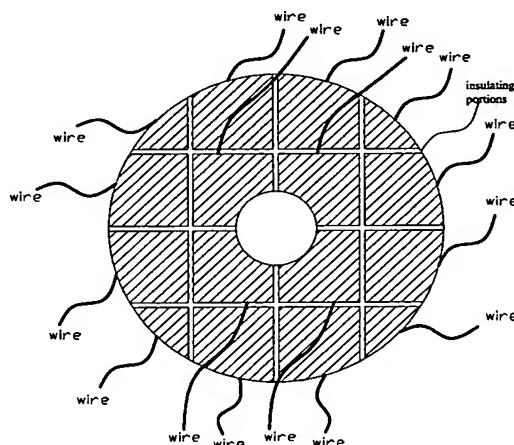
The purpose of Winkler (U.S. Patent No. 6,943,507) is to acquire a stable current value of the electron beam in the electron device.

However, the purpose of the present invention is to measure the magnitude and the direction of the misalignment between the extractor aperture and the emitter. This data could be used for mechanical realignment of the emitter.

Therefore the purpose of the present invention and the cited references is different and unobvious. In addition, the presently claimed invention is not suggested to one ordinary skill in the art to achieve the purpose of the present invention that is to provide the data of misalignment from the cited references.

The extractor of the amended claim 1 comprises sensing regions and insulating portions, wherein misalignment of an extractor aperture with an electron emitter could be determined by measuring and calculating the amount of electrons on each the sensing regions.

Therefore the extractor of the present invention could be used to inspect the amount of misalignment of an extractor aperture with an electron emitter in the micro-column.



Referring to the above drawing, in the extractor of the present invention, the arrangement of each sensing regions is not depended on the aperture of the extractor. Also, if the sensing regions are increased, the magnitude and direction of the misalignment of the emitter with the extractor aperture can be measured more accurately.

In the present invention a mechanical positioner, such as a piezoelectric stage, could be installed in the micro-column to move the emitter for realignment of the emitter with the aperture of the extractor.

In the Chang reference a centering extraction electrode comprises four electrode elements which are separated by insulating layer. The voltages are applied to extraction

electrodes to change or deflect the path of the electron beam. Therefore each electrode must be arranged around the aperture of the extractor and voltages have to be applied to center the electron beam. In the Chang reference, the centering extraction electrode is used to reduce the difficulty of the mechanical alignment and aligning the electron beam to the optical axis by means of deflecting the electron beam. Also, Winkler teaches how to sense the amount of beam current absorbed in the extractor electrode.

The main problem of the manufacturing an ordinary micro-column is the misalignment between the emitter and the aperture of the extractor electrode. However, performing a precise mechanical alignment between emitter and extractor aperture using a positioner is very difficult as disclosed in the Chang reference, and the misalignment can not easily be measured after the manufacturing process but only during performing initial tests for the micro-column installed into a vacuum chamber. The initial test to confirm the proper function of a micro-column is performed by controlling the voltages applied to the emitter and each electrode of the electron lenses to acquire a standard specimen image. If the emitter and the extractor aperture are misaligned, an image of the standard specimen can't be acquired.

Although, during the initial test, it is possible to move physically the emitter with a positioning device such as a piezoelectric stage, it is very difficult to realign the emitter to the extractor aperture in a micro-column installed in a vacuum chamber, since the magnitude and the direction of the misalignment of the emitter with the extractor aperture can not be measured in the conventional micro-column.

Therefore, Chang teaches that the precise alignment between the emitter and the extractor aperture is achieved using deflecting the electron beam with the centering extraction electrodes during processing the initial test or using of a micro-column, since a micro-column makes a electron beam only under the vacuum states.

Although Figures 4 and 6 in the Chang reference show the correction of the electron beam to the optical axis, the correction could be performed after the mechanical pre-alignment and Chang does not teach how to measure the magnitude and the direction of the misalignment. Therefore, if using the correction of Figures 4 and

6 in the Chang reference, it may be necessary to adjust the voltages applied to the centering extractor electrodes and to analyze the image of the standard specimen until achieving an optimized image of the standard specimen by many trial and errors, and to determine the voltage value for each centering extraction electrode.

With respect to the electro-optic system, the mechanical alignment is better than the electro-static alignment in micro-column. Therefore the extractor of the present invention provides the magnitude and the direction of the misalignment between the emitter and the extractor aperture, so that alignment between the emitter and the extractor aperture could be easily achieved with the micro-positioner.

With respect the differences, the extractor of the present invention is different from them of the cited inventions, as follows;

- 1) arranging sensing regions of the extractor of the present invention is independent of the aperture of the extractor,
- 2) it is not necessary to apply voltages to the sensing regions of the extractor of the present invention
- 3) the extractor of the present invention can provide the magnitude and the direction of the misalignment
- 4) the micro-column according to the present invention can have the electro-optic system better than those of Chang and Winkler.

Regarding the effectiveness of the extractor of the present invention, mechanical alignment between the emitter and the extractor aperture could be achieved very effectively and precisely with the extractor of the present invention. Therefore, it is not necessary to deflect the beam to the optic axis.

With respect claims 2 and 3, since, as explained above, since the amended claim 1 is unobvious and claims 2 and 3 are dependent upon claim 1, they are also unobvious. This is similarly true with respect to claims 4, 5, 12, and 13, since claims 4 and 5 relate to a method for aligning an extractor aperture with an electron emitter by using the extractor of claim 1. Accordingly, it is most respectfully requested that these rejections be withdrawn.

Appl. No. 10/538,284
Amendment dated: January 2, 2008
Reply to OA of: July 3, 2007

Claims 6 - 8 relate to a positioning measuring system using the extractor of claim 1 and claims 9 – 11 relate to a measuring or aligning method using the principle of the measurement disclosed in claim 1 and therefore are equally patentable. Accordingly, it is most respectfully requested that this aspect of the rejection be withdrawn.

In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all the claims now present in the application are most respectfully requested.

Respectfully submitted,
BACON & THOMAS, PLLC

By: 
Richard E. Fichter
Registration No. 26,382

625 Slaters Lane, Fourth Floor
Alexandria, Virginia 22314
Phone: (703) 683-0500
Facsimile: (703) 683-1080
REF/cjw
A01.wpd
January 2, 2008